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The new blast furnace of the Bethlehem Steel Company-II

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The New Blast Furnace of the Bethlehem Steel Company—II.

By W. S. Landis, M.S.

(Concluded from May issue, p. 231.)

The blast furnaces of this company are grouped on a narrow strip of land running east and west between the old and the new rights of way of the Lehigh Valley Railroad. This strip is just sufficiently wide to accommodate the engine house, ore bins and cast houses of the older furnaces. With the advent of new furnace construction the first large furnace "E" was arranged to run in an east and west direction, contrary to the others.

The furnace "D" being placed between the old and the new furnaces had to be most compactly arranged, as "E" cut it off from extending in any direction but across the narrow strip of property allotted to the blast-furnace division.

This compact arrangement is shown by the general ground plan, Fig. 6.

The ore, stone and coke pockets on the right are the ones

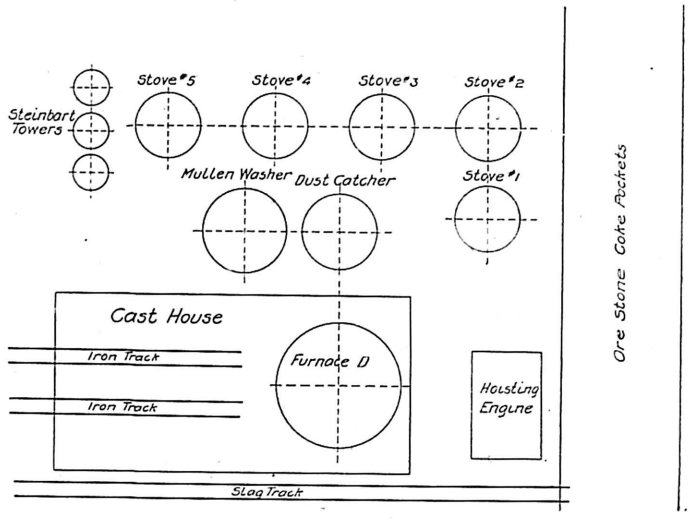

FIG. 6.—GENERAL PLAN OF BLAST FURNACE PLANT.

shown in Fig. 1 of the May issue. The gas-driven blowing engines and dynamos will be placed in a new power house to be erected on the site of the steam shovel in this first photograph.

It is now the intention to electrify all the shops and smaller rolling mills of the immense plant, the power being generated in this new engine house. With the completion of the four large furnaces and this engine house every boiler plant in the works will be dismantled with the exception of the blast-furnace boilers burning from arc gas to supply the steam hammers in the forge shops.

This will require a power generation which will exceed 25,000 hp.

Fig. 7 shows the general lines of the furnace stack. Its principal dimensions are as follows: Height, 90 ft.; diameter of hearth, 15 ft. 6 in.; diameter of top of bosh, 22 ft.; diameter on stock line, 16 ft.; depth of hearth, 8 ft.; height of bosh, 12 ft.; 10 tuyeres, 6 in. in diameter.

The hearth is jacketed with a heavy cast-iron, water-cooled plate extending 6 ft. above and below the center line of the iron notch.

Forty and one-half inches of brick comprise the lining of the hearth.

The bosh walls are 22½ in. thick surrounded by a water box, shown in detail in Fig. 8. A somewhat similar box has been in use on furnace "E" for several years, no trouble having been experienced with this system of cooling so long as care was taken to insure a constant supply of water to it. The inside walls were smooth and regular after blowing out, the ridges

and steps so prominent with plate-cooled boshes being noticeably absent. In one campaign of furnace "E," when through careless attention the water supply was interrupted over one section of the box and a hot spot developed, it was found quite difficult to overcome it as the water when again turned on refused to flow down over the hot plates.

The system of water-cooling employed by Scott in his new furnace bears considerable resemblance to this water-box system which has been in use by the Bethlehem Steel Company for several years.

Above the mantel are placed seven courses of cooling plates 3 ft. apart, 12 plates to the course. A steel wear plate extends downward 12 ft. from just above the stock line.

For charging, the usual inclined bridge carrying balanced skips of 125 cu. ft. capacity is used. A 200-hp motor driving a 6-ft. drum furnishes the power for hoisting. A modified form of the Baker top is used on the furnace, the essential difference being in giving lesser angle between successive positions of the distributor than is found with the ordinary top. In this top considerable lap is given to the distributions.

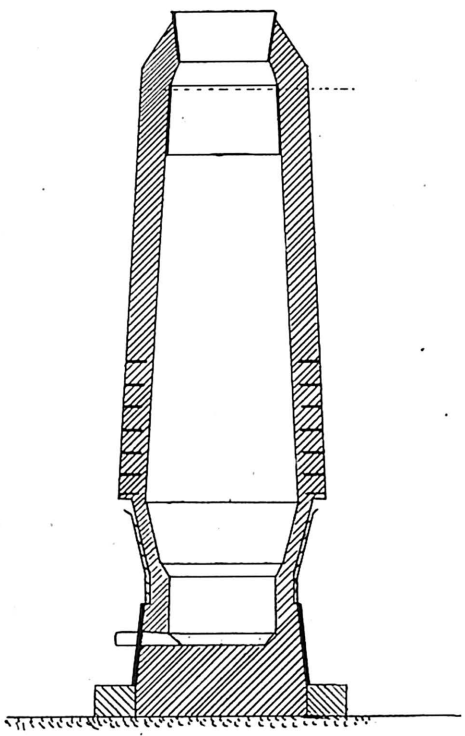

FIG. 7.—GENERAL LINES OF BLAST FURNACE STACK.

Several years ago the distributor on furnace "E" gave considerable trouble by refusing to revolve, although the indicator recorded proper distribution. The result was that the inwall was worn almost through before the trouble was located. It was so far gone that it was either a question of blowing out the furnace or else attempting a repair with the furnace in blast. A patch was decided upon. The furnace was blown down about 40 ft. and 6 ft. to 8 ft. of green sod was rammed in on top of the hot stock as tightly as possible. With this plug in place bricklayers descended 25 ft. down the stack inside and tore out the worn brick, replacing them with new, the work being so skillfully directed that not one was even overcome in the slightest by the furnace gas, though it is true that on account of the great heat the shifts were very short. The furnace ran for several months afterwards on this patch before being blown out. The distributor on "D" has been designed to absolutely avoid any such stoppage of revolution.

The cast house is 56 ft. wide and 111 ft. long. A 25-ton traveling crane serves the casting floor and has its run way extended some 10 ft. beyond the outer end of the house. On a prolongation to the inclined bridge at the top of the furnace is bracketed an overhanging crane with both transverse and longitudinal movement, for serving the top. To enable this crane to reach the ground a panel of the cast-house roof, including a truss, is made removable, a vertical from the crane dropping well in front of the furnace in the cast house to the hot-metal tracks shown in Fig. 6.

The greater portion of the pig iron made by the Bethlehem Steel Company goes direct to the basic steel furnaces, but a smaller portion reaching a casting machine of the Davis type (modified by the steel company to avoid water chilling). The ladles are brought in on two parallel tracks underneath the floor off the cast house. Six ladles can be accommodated at one time, the flow of metal being regulated by the gates and runners shown in Fig. 3 of the May issue of this journal. The slag track is outside of the cast house, the track being extended sufficiently far back to permit of the storage of a car for the reception of clean-up material, etc., from around the furnace.

The ores used by the company require a high temperature for successful smelting.

To this end five 22 ft. x 100 ft. McClure type hot-blast stoves are in use. To ensure their working at their maximum efficiency for a long period of time a thorough cleaning of the gases had to be assured.

After leaving the furnace the gas passes through a conical dust-catcher 25 ft. in diameter. From this it was originally planned to lead the gases through two Mullen washers in series before going to the stoves.

This arrangement was later modified to include only one 28-ft. Mullen washer and in place of the second to use a series of Steinbart towers.

These towers, three in number, each 12 ft. in diameter and 75 ft. high, are connected in multiple between the Mullen and the stoves.

The essential feature of these washers is the use of a rapidly revolving stream of water falling on a rain-making distributor. This insures a very uniform distribution of drops throughout the whole area of the tower, a test made with buckets set at various places in the bottom of the tower showing practically simultaneous filling of them all. A by-pass to the stoves is provided for the gas in case the washers are out of commission. No valves are used in this distribution of gas around the Steinbart towers; instead, the flow is controlled by the emptying or filling of the siphons shown in Fig. 4 of the last issue. At the present time the towers are not yet in operation; there is no question of their cleaning the gases, but the amount of moisture carried over by the gases might be a serious cause of trouble in the future.

The gas is led from the cleaning system directly to the stoves. When all five are in commission four are on gas four hours and one is on air one hour. The question has arisen as to whether there is not too liberal stove capacity when all five are working. With 400,000 brick in each stove, the passage of the blast through one for an hour will cause a drop in temperature of over 100° C. (average drop for the whole mass of brick). This is a rather large drop for uniform conditions regarding blast temperature and for minimum wear and tear on stove lining. It seems that the utilization of one of the stoves as an equalizer would settle the difficulty, certainly much more efficiently than the use of the McCarthy equalizing valve as at present installed in the hot-blast main.

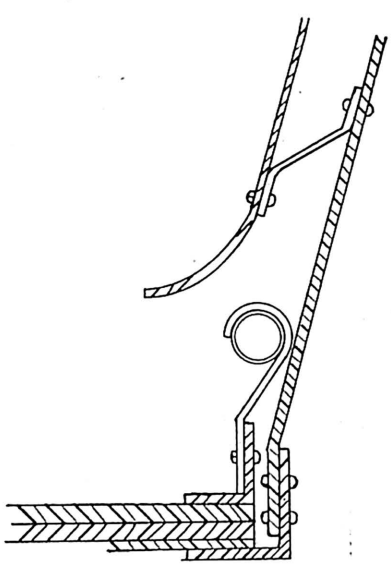

FIG. 8.—DETAILS OF WATER BOX.

On the whole it is a question if these is another furnace in the country more complete in details and appointments than this one, representative as it is of the $13,000,000 worth of improvements now under construction at this Eastern steel plant. In conclusion the author extends his most sincere thanks to the general manager, E. G. Grace, for the many courtesies extended during the preparation of this description.